# *Chapter 3 Homework Solutions*

1. When was the first Corona launch ?
February 28, 1959

2. When was the first successful launch? Which number was it?
August 18, 1960, #13

2. How many launches before they had a successful film return?
Launch #14 was the first successful film return.

3. How did the date of this launch compare to that of the U-2 incident with Gary Powers?
   Powers was shot down on May 1, 1960.

4. What was the best resolution (GSD) of the KH-4 cameras reported upon in this document?
   6 feet

6. What was the swath width associated with the 'best' resolution KH-4 images?
   10 miles

7. How many CORONA missions were there?
# 145

8. List 5 elements of recognition.

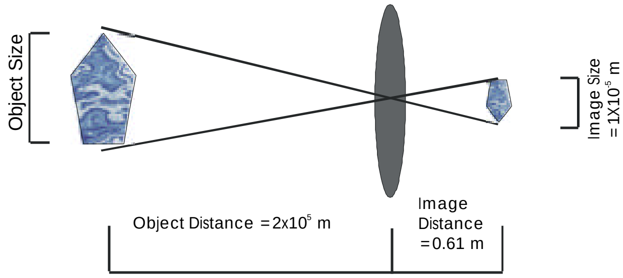
9. How could you tell that a road or rail-line was intended for missile transport?
   No narrow turns….

10. When is the best time of week(day) to inventory an opponent's hardware (seems like it depends on religion...)

11. What is the focal length, diameter, and f/# for the Hubble Primary Optic?
57.6 m, 2.4 meter, f/24

12. Locate a high-quality 200 mm lens for a good 35 mm camera (say a Nikon or Canon). What is the f/#? What diameter is the primary optic?

13. For a 24" focal length camera, f/3.5, at an altitude of 200 km, calculate the GSD corresponding to a 0.01 mm spot on the film. Assume nadir viewing. Note that this is a geometry problem.




$$\frac{\text{Object Size}}{\text{altitude}} = \frac{\text{Image Size}}{\text{focal length}}, \quad \text{or } GSD = \text{Object Size} = \frac{\text{Spot Size}}{\text{focal length}} \bullet \text{altitude}$$

$$GSD = \frac{10^{-5}}{0.61} \bullet 2\times10^{5} = 3.3 \text{ m}$$

14. For a 24" focal length, f/3.5 lens, calculate the Rayleigh limit to GSD for a satellite at 200 km altitude. Assume nadir viewing, visible light (500 nm)

First you need to get the lens diameter:

$$f/\# = \frac{\text{Focal Length}}{\text{Diameter}} \rightarrow \text{D} = \frac{\text{Focal Length}}{f/\#} = \frac{24"}{3.5} = 6.86 \text{ inches}$$

D = 17.4 cm or 0.174 m

$$GSD = \Delta q \bullet altitude = \frac{l}{\text{D}} \bullet \text{altitude} = \frac{5\times10^{-7}}{0.174} \bullet 2\times10^{5} = 0.57 \text{ m}$$

Note that this number is smaller than the answer to the problem above. For the scenario given here, the limiting factor in resolution is the detector (film) resolution - and the geometry of the optics.

15. What diameter mirror would be needed to achieve 12 cm resolution (GSD) at geosynchronous orbit (6.6 Re, geocentric - note that this is **not** the altitude)

Altitude = $5.6 \bullet 6380\times10^{3} \text{ m} = 3.57\times10^{7} \text{ m}$

$$GSD = \frac{l}{\text{D}} \bullet \text{altitude} \Rightarrow Diameter = \frac{l}{\text{GSD}} \bullet \text{altitude}$$

$$Diameter = \frac{5\times10^{-7} \text{ m}}{0.12 \text{ m}} \bullet 3.6\times10^{7} = 150 \text{ m}$$